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[List of Attached Documents]

[Article]	Specification	1
[Article]	Drawings	1
[Article]	Abstract	1
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[Designation of Document] SPECIFICATION

[Title of the Invention] Film forming apparatus and film forming method

[Claims]

[Claim 1] A film forming apparatus characterized by comprising:

rotating means for rotating a substrate; and

a film forming liquid supplying device which, during rotation of said rotating means, supplies film forming liquid onto said substrate.

[Claim 2] The film forming apparatus according to claim 1, characterized in that a non-film-forming region to which said film forming liquid is not applied is disposed in said substrate, and that said film forming liquid supplying device supplies said film forming liquid to a region outside said non-film-forming region.

[Claim 3] The film forming apparatus according to claim 1 or 2, characterized in that said film forming liquid supplying device comprises a liquid reservoir, which stores said film forming liquid, and

that said film forming liquid, which is stored in said liquid reservoir, is supplied onto said substrate through a supply port, which communicates with said liquid reservoir.

[Claim 4] The film forming apparatus according to claim 3, characterized in that said film forming liquid is

supplied through said supply port by applying an air pressure to said film forming liquid, which is stored in said liquid reservoir.

[Claim 5] The film forming apparatus according to claim 3 or 4, characterized in that said liquid reservoir is rotatable together with said rotating means.

[Claim 6] The film forming apparatus according to claim 5, characterized in that said film forming liquid is supplied through said supply port by applying a centrifugal force due to rotation of said rotating means to said film forming liquid, which is stored in said liquid reservoir.

[Claim 7] The film forming apparatus according to any one of claims 1 to 6, characterized in that said substrate is an optical disc substrate.

[Claim 8] A film forming method characterized by comprising s a supplying step of supplying a film forming liquid onto a substrate while said substrate is rotated by rotating means.

[Claim 9] The film forming method according to claim 8, characterized in that a non-film-forming region to which said film forming liquid is not applied is disposed in said substrate, and that in said supplying step, said film forming liquid is supplied to a region outside said non-film-forming region.

[Claim 10] The film forming method according to claim

8 or 9, further comprising a step of storing said film forming liquid into a liquid reservoir, and the film forming method characterized in that in said supplying step, said film forming liquid, which is stored in said liquid reservoir, is supplied onto said substrate through a supply port, which communicates with said liquid reservoir.

[Claim 11] The film forming method according to any one of claims 8 to 10, characterized in that in said supplying step, said film forming liquid is supplied through said supply port by applying an air pressure to said film forming liquid, which is stored in said liquid reservoir.

[Claim 12] The film forming method according to claim 10 or 11, characterized in that said liquid reservoir is rotatable together with said rotating means.

[Claim 13] The film forming method according to claim 12, characterized in that said film forming liquid is supplied through said supply port by applying a centrifugal force due to rotation of said rotating means to said film forming liquid, which is stored in said liquid reservoir.

[Claim 14] The film forming method according to any one of claims 8 to 13, characterized in that said substrate is an optical disc substrate.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Belongs]

The present invention relates to a film forming apparatus and a film forming method in which a film can be formed while controlling the thickness of the film.

[0002]

[Conventional Art]

A cover layer which covers the surface of an optical disc has a thickness of about 100 μm. As a method of forming such a layer, known is a method using a spin coater. In the method, an ultraviolet curing resin is dropped on an optical disc substrate which is placed on a turntable, and the optical disc substrate is then rotated at a high speed by the turntable, whereby the ultraviolet curing resin is spread over the entire face of the optical disc substrate. This method is advantageous from the viewpoint of the production cost, because a resin which is spun off from the spin coater can be reused.

[0003]

[Problems that the Invention is to Solve]

In an optical disc substrate, an opening is formed in the center. Therefore, there arises a problem in that it is difficult to form a uniform cover layer because of the positional relationship between the position to which an ultraviolet curing resin is supplied, and that where the

cover layer is formed. That is, there is a problem in that, when the ultraviolet curing resin is dropped in the inner peripheral area of the substrate and then spun off by high-speed rotation, the film thickness distribution of the ultraviolet curing resin is formed so as to be thin in the inner peripheral area and thick in the outer peripheral area. When the resin dropping position is moved to a further inward position in order to uniformalize the film thickness, there arises other problems such as that the resin leaks through the opening of the optical disc substrate to soil the turntable.

[0004]

It is an object of the invention to provide a film forming apparatus and a film forming method in which a film can be formed while controlling the thickness of the film.

[0005]

[Means for Solving the Problems]

The film forming apparatus according to the invention is characterized by comprising rotating means (1) for rotating a substrate (3); and a film forming liquid supplying device (2) which, during rotation of the rotating means (1), supplies film forming liquid (4) onto the substrate (3).

[0006]

According to this film forming apparatus, since the

film forming liquid is supplied during a period when the substrate is rotated, the film thickness can be adequately controlled. For example, the thickness of a film in the vicinity of a portion to which the film forming liquid is supplied can be increased. In this case, the rotational speed of the rotating means may be changed during the supply of the film forming liquid, or the supplied amount of the film forming liquid during rotation of the rotating means may be changed. The supply of the film forming liquid may be started before the rotation of the rotating means is started.

[0007]

A non-film-forming region (3a) to which the film forming liquid is not applied may be disposed in the substrate (3), and the film forming liquid supplying device (2) may supply the film forming liquid (4) to a region outside the non-film-forming region (3a). In this case, the film forming liquid is supplied to the region outside the non-film-forming region, the film forming liquid is spread further outward by the centrifugal force due to rotation of the substrate, and hence the film is formed in only the region outside the non-film-forming region.

[0008]

The film forming liquid supplying device (2) may comprise a liquid reservoir (31) which stores the film

forming liquid (4), and the film forming liquid (4) which is stored in the liquid reservoir (31) may be supplied onto the substrate (3) through a supply port (32) which communicates with the liquid reservoir (31). For example, the supply port may be a slit or a nozzle.

[0009]

The film forming liquid (4) may be supplied through the supply port (33) by applying an air pressure to the film forming liquid (4) which is stored in the liquid reservoir (31). In this case, the film forming liquid can be surely supplied without using, for example, a centrifugal force. The supplied amount of the film forming liquid can be controlled by adjusting the air pressure. The air pressure may be changed during rotation of the rotating means.

[0010]

The liquid reservoir (31) may be rotatable together with the rotating means (1).

[0011]

The film forming liquid (4) may be supplied through the supply port (33) by applying a centrifugal force due to rotation of the rotating means (101) to the film forming liquid (4) which is stored in the liquid reservoir. In this case, the film forming liquid may be supplied by the centrifugal force without applying an air pressure to the

liquid reservoir.

[0012]

The substrate may be an optical disc substrate (3).

[0013]

The film forming method according to the invention is characterized by comprising a supplying step of supplying a film forming liquid (4) onto a substrate (3) while the substrate (3) is rotated by rotating means.

[0014]

In the film forming method, since the film forming liquid is supplied during a period when the substrate is rotated, the film thickness can be adequately controlled. For example, the thickness of a film in the vicinity of a portion to which the film forming liquid is supplied can be increased. In this case, the rotational speed of the rotating means may be changed during the supply of the film forming liquid, or the supplied amount of the film forming liquid during rotation of the rotating means may be changed. The supply of the film forming liquid may be started before the rotation of the rotating means is started.

[0015]

A non-film-forming region (3a) to which the film forming liquid (4) is not applied may be disposed in the substrate (3), and the film forming liquid supplying device (2) may supply the film forming liquid to a region outside

the non-film-forming region (3a). In this case, the film forming liquid is supplied to the region outside the non-film-forming region, the film forming liquid is spread further outward by the centrifugal force due to rotation of the substrate, and hence the film is formed in only the region outside the non-film-forming region.

[0016]

The method may further comprise a step of storing the film forming liquid (4) into a liquid reservoir (31), and, in the supplying step, the film forming liquid (4) which is stored in the liquid reservoir (31) is supplied onto the substrate (3) through a supply port (32) which communicates with the liquid reservoir (31). For example, the supply port may be a slit or a nozzle.

[0017]

In the supplying step, the film forming liquid (4) may be supplied through the supply port (32) by applying an air pressure to the film forming liquid (4) which is stored in the liquid reservoir (31). In this case, the film forming liquid can be surely supplied without using, for example, a centrifugal force. The supplied amount of the film forming liquid can be controlled by adjusting the air pressure. The air pressure may be changed during rotation of the rotating means.

[0018]

The liquid reservoir (31) may be rotatable together with the rotating means (1).

[0019]

A centrifugal force due to rotation of the rotating means (101) may be applied to the film forming liquid (4) which is stored in the liquid reservoir, whereby the film forming liquid (4) is supplied through the supply port (33). In this case, the film forming liquid may be supplied by the centrifugal force without applying an air pressure to the liquid reservoir.

[0020]

The substrate may be an optical disc substrate (3).

[0021]

In order to facilitate understanding of the invention, the reference numerals used in the accompanying drawings are appended in the parentheses. However, this does not limit the invention to embodiments shown in the drawings.

[0022]

[Mode for Carrying Out the Invention]

-First embodiment-

Hereinafter, a first embodiment of the film forming apparatus of the invention will be described with reference to Figs. 1 to 4. Fig. 1 is a section view showing the film forming apparatus of the embodiment, and Fig. 2 is a section view taken along line II-II in Fig. 1.

[0023]

As shown in Figs. 1 and 2, the film forming apparatus 100 of the embodiment comprises: a turntable 1 of a spin coater on which an optical disc substrate 3 is to be placed; and a film forming liquid supplying device 2, which is placed above the optical disc substrate 3.

[0024]

The film forming liquid supplying device 2 comprises: a cylindrical unit 2A which generally has a substantially cylindrical shape; a fixing unit 2B which is connected to the cylindrical unit 2A; and an insertion unit 2C which is inserted into the cylindrical unit 2A in a rotatable manner.

[0025]

In the cylindrical unit 2A, a support portion 21 for supporting the fixing unit 2B is formed. The support portion 21 comprises: a column part 21a which has a columnar shape, and which is to be connected to the fixing unit 2B; and beam parts 21b which protrude toward the inside of the cylindrical unit 2A to support the column part 21a. Openings 21c through which the interior 31 of the cylindrical unit 2A vertically communicates are formed among the beam parts 21b. In the cylindrical unit 2A, flanges 22 and 23 are projected toward the inside of the cylindrical unit 2A. An O-ring 22a serving as a packing is fitted into the inner peripheral face of the flange 22, and

an O-ring 23a serving as a packing is fitted into the inner peripheral face of the flange 23.

[0026]

The fixing unit 2B has a truncated conical portion 24, and a disc portion 25, which is connected to the lower face of the truncated conical portion 24. The upper face of the truncated conical portion 24 is joined to the lower face of the column part 21a. The lower face of the disc portion 25 is contactable with the upper face of the optical disc substrate 3.

[0027]

The insertion unit 2C comprises a cylindrical portion 26, and a flange 27 which outward protrudes from the cylindrical portion 26. As shown in Fig. 1, a bearing 28 is sandwiched between the outer peripheral face of the flange 27, and the inner wall face of the cylindrical unit 2A, which is interposed between the flanges 22 and 23. The O-ring 22a above the flange 27, and the O-ring 23a below the flange 27 are in contact with the outer peripheral face of the cylindrical portion 26. A supply pipe 29 is connected to an upper end portion of the cylindrical portion 26 of the insertion unit 2C.

[0028]

Next, the procedure of forming a cover layer on the optical disc substrate 3 by using the film forming

apparatus 100 will be described with reference to Figs. 3 and 4. Fig. 3 is a section view showing the manner of supplying an ultraviolet curing resin by the film forming apparatus 100, and Fig. 4 is a section view showing a state where the cover layer is formed on the optical disc substrate.

[0029]

As shown in Fig. 3, the optical disc substrate 3 is placed on the turntable 1. At this time, the optical disc substrate 3 is positioned by passing the rotation shaft 1A of the turntable 1 through an opening 3a which is formed in the center of the optical disc substrate 3.

[0030]

Next, the film forming liquid supplying device 2 is placed at a predetermined position above the optical disc substrate 3, so that the lower face of the disc portion 25 of the fixing unit 2B is in contact with the upper face of the optical disc substrate 3. As a result, the opening 3a of the optical disc substrate 3 is closed by the disc portion 25.

[0031]

Then, the turntable 1 is rotated at a high speed. At this time, since the cylindrical unit 2A and the insertion unit 2C are enabled to be mutually rotatable by the bearing 28 and the insertion unit 2C is fixed so as not to be

rotated, the optical disc substrate 3, the fixing unit 2B, and the cylindrical unit 2A are integrally rotated together with the turntable 1, but the insertion unit 2C and the supply pipe 29 are not rotated. A predetermined amount of an ultraviolet curing resin 4 is then supplied from the supply pipe 29 into the interior 31 of the cylindrical unit 2A. The ultraviolet curing resin 4 is moved by gravity to a lower portion of the cylindrical unit 2A. Thereafter, an air pressure is applied through the supply pipe 29. At this time, since the air tightness between the cylindrical unit 2A and the insertion unit 2C is maintained by the O-rings 22a and 23a, the pressure of the interior 31 of the cylindrical unit 2A is raised, and the ultraviolet curing resin 4 which is stored in the lower portion of the cylindrical unit 2A is gradually pushed out onto the optical disc substrate 3 through a slit 32 that is formed between the lower end face the cylindrical unit 2A and the upper face of the disc portion 25. The resin 4 which has passed through the slit 32 is spread toward the outer periphery of the optical disc substrate 3 by the centrifugal force due to rotation of the turntable 1, so that a film of the resin 4 is formed on the surface of the optical disc substrate 3. The width of the slit 32, and the air pressure are set so as to attain an adequate supply speed of the resin 4 in relation with the viscosity and

affinity of the resin 4.

[0032]

In the embodiment, also during rotation of the turntable 1, the ultraviolet curing resin 4 is supplied with starting from the inner peripheral side of the optical disc substrate 3. In the embodiment, therefore, a film of a sufficient thickness is formed in the inner peripheral side of the optical disc substrate 3 in comparison to the case where, after the supply of a resin is ended, an unnecessary amount of the resin is spun off by rotation, with the result that a uniform cover layer can be formed over the entire face of the optical disc substrate 3.

[0033]

Thereafter, the film of the ultraviolet curing resin 4 is irradiated with ultraviolet rays, so that the ultraviolet curing resin 4 cures to form a cover layer 4A as shown in Fig. 4. The amount of the ultraviolet curing resin 4 which is spun off by rotation of the turntable 1 is recycled and reused.

[0034]

In the embodiment, the ultraviolet curing resin is supplied by pushing out the resin by using an air pressure. Alternatively, the ultraviolet curing resin may be supplied by using only the centrifugal force due to rotation of the turntable 1 and the weight of the resin 4.

[0035]

-Second embodiment-

Hereinafter, a second embodiment of the film forming apparatus of the invention will be described with reference to Figs. 5 and 6. Fig. 5 is a section view showing the film forming apparatus of the embodiment.

[0036]

As shown in Fig. 5, the film forming apparatus 200 of the embodiment comprises: a turntable 101 of a spin coater on which the optical disc substrate 3 is to be placed; and a film forming liquid supplying device 102 which is placed above the optical disc substrate 3.

[0037]

The film forming liquid supplying device 102 comprises a cylindrical unit 102A which generally has a substantially cylindrical shape. Slits 33 through which the interior and the exterior of the cylindrical unit 102A communicate with each other are circumferentially formed in a lower portion of the cylindrical unit 102A. In the cylindrical unit 102A, portions which are respectively above and below the slits 33 are connected to each other by beams that are not shown.

[0038]

Next, the procedure of forming a cover layer on the optical disc substrate 3 by using the film forming apparatus 200 will be described with reference to Fig. 6.

Fig. 6 is a section view showing the manner of supplying an ultraviolet curing resin by the film forming apparatus 200.

[0039]

As shown in Fig. 6, the optical disc substrate 3 is placed on the turntable 101. At this time, the optical disc substrate 3 is positioned by passing the rotation shaft 101A of the turntable 101 through the opening 3a which is formed in the center of the optical disc substrate 3.

[0040]

Next, the cylindrical unit 102A is placed at a predetermined position above the optical disc substrate 3. At this time, the cylindrical unit 102A is fixed to the position where the unit is not in contact with the optical disc substrate 3 and the rotation shaft 101A.

[0041]

Then, the turntable 1 is rotated at a high speed. At this time, the optical disc substrate 3 is rotated, but the cylindrical unit 102A is not rotated. A predetermined amount of the ultraviolet curing resin 4 is then supplied into the interior of the cylindrical unit 102A. The ultraviolet curing resin 4 is moved by gravity to a lower portion of the cylindrical unit 102A. Thereafter, an air pressure is applied from an upper portion of the cylindrical unit 102A, whereby the pressure of the interior

of the cylindrical unit 102A is raised, so that the ultraviolet curing resin 4 which is stored in the lower portion of the cylindrical unit 102A is gradually pushed out onto the optical disc substrate 3 through a slit 33 that is formed in the cylindrical unit 102A. The resin 4 which has passed through the slit 33 is spread toward the outer periphery of the optical disc substrate 3 by the centrifugal force due to rotation of the turntable 101, so that a film of the resin 4 is formed on the surface of the optical disc substrate 3. The width of the slit 33, and the air pressure are set so as to attain an adequate supply speed of the resin 4 in relation with the viscosity of the resin 4.

[0042]

In the embodiment, in the same manner as the first embodiment, also during rotation of the turntable 101, the ultraviolet curing resin 4 is supplied with starting from the inner peripheral side of the optical disc substrate 3. Therefore, a film of a sufficient thickness is formed in the inner peripheral side of the optical disc substrate 3, with the result that a uniform cover layer can be formed over the entire face of the optical disc substrate 3.

[0043]

Thereafter, the film of the ultraviolet curing resin 4 is irradiated with ultraviolet rays, so that the

ultraviolet curing resin 4 cures to form a cover layer. The amount of the ultraviolet curing resin 4 which is spun off by rotation of the turntable 101 is recycled and reused.

[0044]

Although, in the embodiments, formation of a cover film of an optical disc has been described as an example, the invention can be applied to a wide variety of cases where a film of a predetermined thickness is formed by the spin coat method.

[0045]

The invention is not restricted to the embodiments. In place of the turntable, rotating means for, placed above the substrate, sucking the surface of the substrate and rotating the substrate may be used.

[0046]

In place of the ultraviolet curing resin, a thermosetting resin may be used.

[0047]

The supply of the film forming liquid may be performed not only during rotation of the rotating means but also before the rotation.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a section view showing a film forming apparatus of a first embodiment.

[Fig. 2]

Fig. 2 is a section view taken along line II-II in Fig. 1.

[Fig. 3]

Fig. 3 is a section view showing the manner of supplying an ultraviolet curing resin by a film forming apparatus 100.

[Fig. 4]

Fig. 4 is a section view showing a state where a cover layer is formed on an optical disc substrate.

[Fig. 5]

Fig. 5 is a section view showing a film forming apparatus of a second embodiment.

[Fig. 6]

Fig. 6 is a section view showing the manner of supplying an ultraviolet curing resin by a film forming apparatus 200.

[Description of the Reference Numerals and Signs]

1 turntable

2 film forming liquid supplying device

3 optical disc substrate (substrate)

3a opening (non-film-forming region)

4 ultraviolet curing resin (film forming liquid)

31 interior (liquid reservoir)

32 slit (supply port)

33 slit (supply port)

101 turntable

102 film forming liquid supplying device

[Designation of Document] ABSTRACT

[Abstract]

[Problem] A film forming apparatus and a film forming method in which a film can be formed while controlling the thickness of the film are provided.

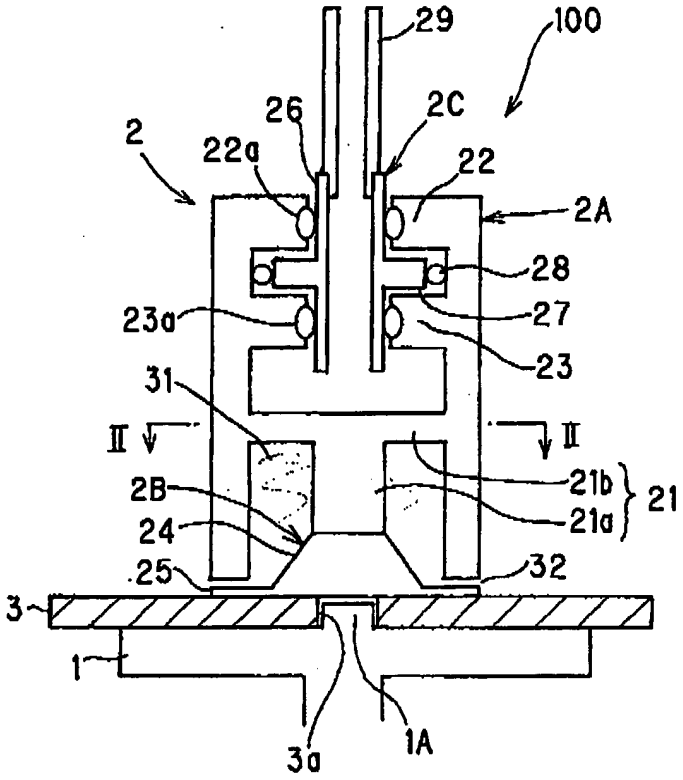
[Means for Resolution] The film forming apparatus has: a turntable 1 which rotates an optical disc substrate 3; and a film forming liquid supplying device 2 which supplies an ultraviolet curing resin 4 onto the optical disc substrate 3, wherein while the optical disc substrate 3 is rotated by the turntable 1, the ultraviolet curing resin 4 is supplied onto the optical disc substrate 3 by the film forming liquid supplying device 2.

[Selected Figure] Fig. 1

【書類名】 ~~図面~~ Drawings

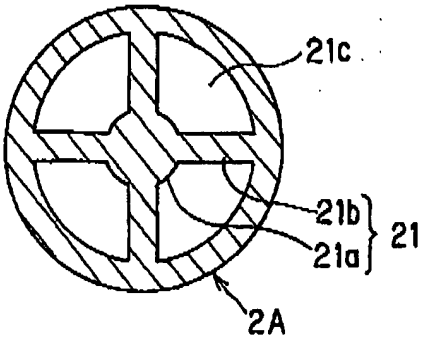
【~~図1~~】 Designation of Document

Fig. 1



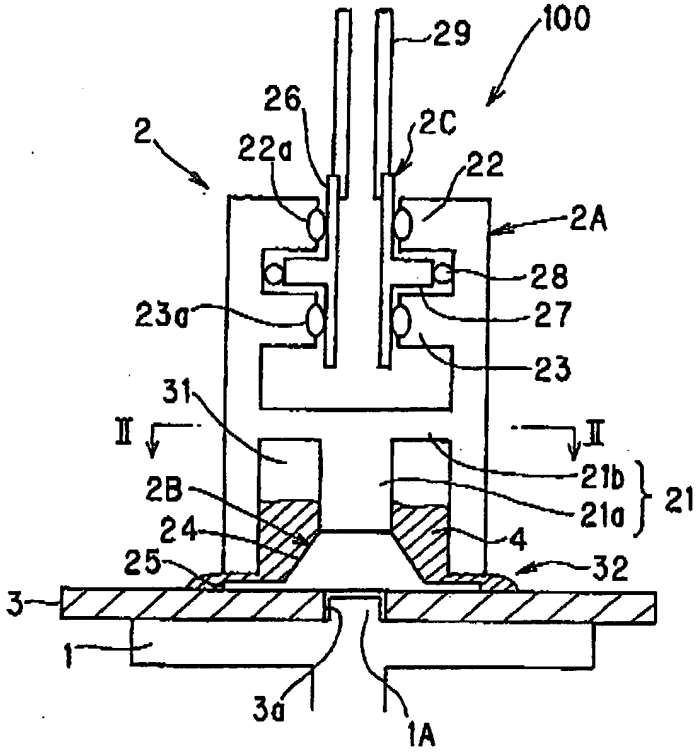
【~~図2~~】

Fig. 2



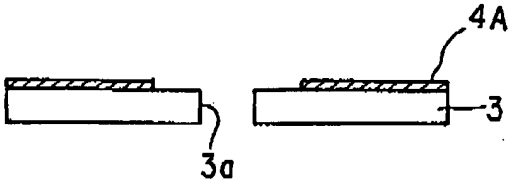
【~~図3~~】

Fig.3



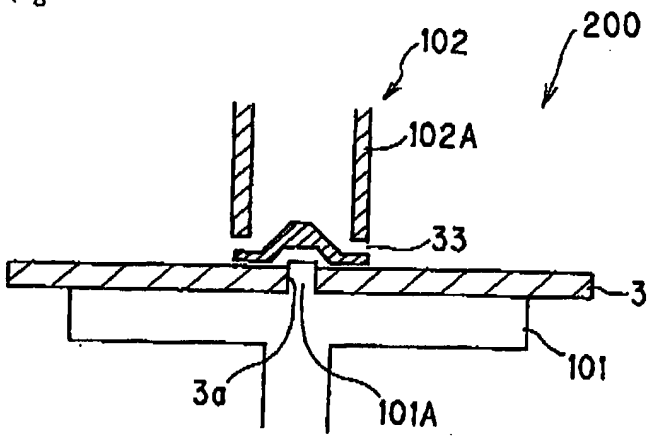
【~~図4~~】

Fig.4



【~~図5~~】

Fig.5



【~~図6~~】

Fig.6